adhered to throughout. Sometimes centimetres are employed, and sometimes millimetres. This is of no consequence, except so far as it tends to keep alive and propagate the state of confusion from which the C.G.S. system might have been expected to deliver the scientific world.

The first part of the book deals with the mechanics of solids, liquids, and gases. The usual methods of measuring lengths, &c., are described, and an account is given of experiments on the balance, on the laws of the pendulum, on elasticity, and on acoustics. The greater portion of the space is devoted to experiments with liquids and gases. The full account which is given of the methods of making measurements of a mechanical nature upon matter in these two states, should be very useful to the students for which the book is designed.

The second division, which is devoted to heat, is excellent. A large number of experiments are described, most of them of great importance to the modern chemist. In this connection may be mentioned specially the sections dealing with melting points, the effect of dissolved substances on the freezing and boiling points of liquids, and the amount of heat evolved in solution and chemical combination. A section is devoted to the determination of the mechanical equivalent of heat by the aid of what is practically a model of Joule's apparatus.

Optical measurements and observations occupy the next portion. Some simple experiments with reflecting surfaces, lenses, and prisms are given, so as to form an introduction to the subject. A few simple experiments with combinations of lenses with lenses or mirrors would have been of much use here, for students generally find difficulty with such experiments, and require some little experience before they can deal practically with the real or virtual images which are seen in mid-space, and not down the tube of a telescope. A large part of the section is devoted to spectrum analysis, and there are some excellent plates of emission and absorption spectra. A short account of the phenomena of polarisation leads up to a chapter on the rotation of the plane of polarisation by various substances, and the use of this property for saccharimetry and other purposes.

The last division of the book, which is devoted to electricity and magnetism, is somewhat abbreviated, only those parts of the subject being included which are supposed to be of interest to the chemist. Voltaic electricity practically takes up the whole of the space. The same omission of definitions, which has been already noticed, shows itself strongly here, no definition being given of either the ampere, the volt, or the ohm, while the enunciation of Ohm's Law is just what a schoolboy might be expected to put down. Although a tangent galvanometer is described, no hint is given that it is possible to calculate its "reduction factor" if the value of "H" is known, and, in fact, the electromagnetic definitions of the units seem quite kept out of sight. From a physical point of view, this division compares quite unfavourably with the three other divisions.

The volume is brought to a conclusion by a useful collection of numerical tables, physical and mathematical.

In spite of the defects which have seemed to call for notice, the book is undoubtedly a useful one, the defects being such as the teacher can very easily remove. If a third edition is called for, it is to be hoped that the authors may see their way themselves to remove them.

The book will often be of service to those teachers who are engaged in the task of conducting classes in practical physics, for it will often suggest fresh experiments to be added to those forming the regular course of the laboratory. But it must be remembered that although a demonstrator in the course of a few years may acquire a knowledge of a large number of experimental methods, yet the students who come under his care for a year or so have only time to acquire a very limited acquaintance with the subject, so that if a new experiment is added to the course, it practically displaces some old one. The course of experiments which is most suitable for students of a particular type working for a particular end, very soon settles itself by a process of selection, and then must remain practically unchanged, although there may be a gradual evolution in the employment of improved methods.

G. F. C. SEARLE.

OUR BOOK SHELF.

Object Lessons in Elementary Science. By Vincent T. Murché. Three volumes. (London: Macmillan and Co., 1894.)

WHEN a child is shown any object, he usually asks "What is it?" and then "What does it do?" If these questions are sensibly answered the child learns much about the properties of common things while he is very young, and, what is more, his faculty of observation is developed. Evidently, then, an excellent grounding for a scientific education can be obtained from object lessons. Simple objects are brought under the children's notice, and their peculiarities observed. For instance, liquids such as water, oil, wine, milk, and quicksilver are taken and used to show that they flow, break up into drops, have no shape of their own, and keep a level surface. Physical properties of solids can then be treated; but whatever the subject of the object lesson, the aim of the teacher must be to let the class come to their own conclusions upon the points illustrated. This principle of sound instruction is well exemplified by the lesson on hard and soft bodies in the first of the three volumes before us. The aim of the lesson is to enable a child to express clearly (1) what he understands by "hard" and "soft"; (2) that hardness and softness are merely relative terms; (3) how to test the hardness of a body. Such objects as an apple, a turnip, a potato, cork, chalk, wood, lead, iron, flint, steel and glass are taken, and children are asked to scratch them with the finger-nail. It is then found that some of the objects can be scratched easily, others not so easily; a third class can only be scratched with difficulty, and a fourth cannot be marked at all with the finger-nail. The experiments are afterwards repeated with a knife, and then the objects are rubbed against one another, and the results noticed. By these means the pupils learn that there are many degrees of hardness, some bodies which are commonly called hard being really soft when compared with others; *e.g.* lead is hard when compared with wood, but soft when compared with iron, and so on. To our minds, this method of teaching elementary science is admirable. It must not be supposed however, that Mr. Murché only deals with physical conditions. His excellent little volumes are also concerned with the chemistry of common things, with the mechanics of every-day life, with zoology, botany, and physiology, and with various arts and manufactures. The volumes follow a scheme of object teaching in elementary science

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issued by the London School Board some years ago. The author adopted this scheme for use in his school as soon as it was issued, and the experience gained since then has enabled him to produce a thoroughly practical work We know no better work for teaching elementary science to young children. Though designed for Standards I. to VI. of Board and National schools, most of our private, and many of our public, schools would gain by introducing these object lessons into their curricula.

Précis de Météorologie Endogène. By F. Canu. (Paris: Gauthier-Villars et Fils, 1894.)

LA MÉTÉOROLOGIE ENDOGÈNE is, according to the author's definition, concerned with (1) all acoustic and dynamic phenomena produced more or less directly by variations of atmospheric pressure within the earth's crust; (2) internal manifestations of electricity and magnetism. Ritter gave this branch of knowledge its name, but it was De Rossi who reduced it to a system. M. Canu's volume is an elementary description of phenomena belonging to the physics of the earth. Among the subjects dealt with are the aurora and its connection with the sun; earth currents; subterranean noises, and circumstances affecting them; terrestrial magnetism; earthquakes and earth tremors; and causes producing the escape of fire-damp. All these phenomena are first treated descriptively, and then in relation to other phenomena. Thus, after descriptions of the height, spectroscopic features, acoustic properties, electric character, and geographical distribution of auroræ, we find brief statements of all the causes believed to influence the phenomena. This plan is followed in each chapter, and though the correlation between the phenomena described is sometimes very doubtful, in general the observations quoted deserve consideration. "Pour propager une science," says the author, "il faut avant tout la vulgariser." To accomplish this object the book has been made easily understandable to a French-reading public.

Sach- und Orts-Verzeichnis zu den mineralogischen und geologischen Arbeiten von Gerhard vom Rath. Im Auftrage der Frau vom Rath bearbeitet von W. Bruhns und K. Busz. Pp. 197. (Leipzig: Engelmann, 1893.)

THIS book is a tribute by the widow of Prof. vom Rath, of Bonn, to the memory of her late husband. It had been her wish to republish his numerous memoirs in a collected edition, but the expense of reproduction of the elaborate crystal drawings with which his researches have been illustrated was found to be prohibitory; hence the tribute has taken the form of a detailed Index to his works. The plan adopted for the Index is identical with that of the useful Repertorium of the "Zeitschrift für Krystallographie und Mineralogie von P. Groth." There are two alphabetically arranged lists, the one a subject-index, the other a locality-index. The crystallographical and mineralogical part is the work of Dr. Busz, while for the petrographical and geological part Dr. Bruhns is responsible. The Index gives striking evidence of the vast range of Prof. vom Rath's studies and observations, while the high standard of excellence which characterised his work is known to all who have occasion to refer to his memoirs. By reason of the diversity of the species and subjects discussed by him, this Index will be of great advantage to students of mineralogy.

Elementi di Fisica. Vols. I. and II. By Antonio Ròiti. (Florence: Successori Le Monnier, 1891 and 1894.)

THE first volume of the third edition of this work was published in 1891, but the second volume, revised and enlarged, has only recently appeared. The two constitute an admirably-arranged work on general physics, similar in structure to Ganot's "Natural Philosophy." After an introduction on the properties of matter, Prof. Ròiti passes to the mechanics of solids, and then to the mechanics of fluids. The next section is devoted to acoustics, after which come chapters on heat and energy. These conclude the first volume; the second being concerned with radiant energy, and electricity and magnetism. There are nearly nine hundred illustrations in the complete work, but the majority of them are old friends. However, scientific judgment has been used in making the compilation, and the only matter for complaint is the absence of an index—a common defect of continental publications. In a work of science having the scope of that under review, such an omission is unpardonable.

LETTERS TO THE EDITOR.

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Latitude by Ex-Meridian.

THE problem under consideration is that of finding latitude by an altitude of a heavenly body taken near the meridian, commonly called the "Ex-Meridian." The method most frequently employed by navigators is that in which a reduction is applied to the observed altitude in order to reduce it to the meridian, this reduction being either found by calculation or taken by inspection from special tables such as the "Ex-Meridian Altitude Tables," by Messrs. Brent, Walter, and Williams. In the following it is proposed to show how this reduction may be effected by the use of the Azimuth and Traverse Tables.

If l be the latitude, d the declination, and h the hour angle, the formula of reduction is

$$x = \mathrm{C}h^2 \quad \ldots\ldots\ldots\ldots \quad (1)$$

where

$$\mathrm{C} = \frac{\cos l \cos d}{2 \sin (l-d)} \left(\frac{\sin^2 15'}{\sin 1''} \right) \text{(Godfray's "Astronomy")}$$

Now since C may be considered constant

$$dx \text{ or } dl = 2\,\mathrm{C}h\,dh \quad \ldots\ldots\ldots \quad (2)$$

Again from the fundamental relation

$$\cos d \cos l \cos h = \cos z - \sin d \sin l$$

it is easily found that

$$dl = dh \cos l \tan \mathrm{A} \quad \ldots\ldots\ldots \quad (3)$$

where A is the azimuth, and eliminating C between (1) (2) and (3) the formula is obtained in the simple form

$$x = \tfrac{1}{2}\, h \cos l \tan \mathrm{A}$$

which expresses the reduction in minutes of arc, h being the number of minutes of arc in the hour angle.

As an example of the use of this formula, take the observation given at the beginning of the Brent Tables.

Date, November 18, D.R. latitude 51° north, hour angle 0h. 24m. 54s., declination 19° 20′ 43″ south, and altitude 19° 29′ 18″. Required the true latitude.

From Burdwood's Azimuth Tables the bearing is found to be about 6° 15′, and we have

$$x = 186'{\cdot}75 \cos 51^\circ \tan 6^\circ\, 15' = 12'\, 48''$$

giving a latitude 50° 57′ 11″ north.

The result found in the book is 50° 57′ 10″ north.

To find the reduction by the Traverse Table we may proceed as follows:—With 187 as distance and 51° as course, we have d lat. 117′·7; with this as d lat. and 6° 15′ as course, we have in the departure column 12′·8, which agrees with the result found above.

A difficulty attending the above method is that the Burdwood Tables do not give the azimuths of bodies having an altitude greater than 60°, and are only calculated for bodies whose declinations do not exceed the maximum declination of the sun. However, this should hardly be sufficient to condemn the

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